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PRECISION AND THE BLUE COLLAR ARTILLERY

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ABSTRACT

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The well documented success of artillery precision munitions during Operation Iraqi Freedom and the concern for minimizing collateral damage in follow on peace keeping operations and urban combat have generated a lively debate around what types of munitions are best for countering the threats for the 21st century. As the field artillery labors to comply with the organizational and training ramifications of Army Transformation, it seeks to remain relevant to the Army's current focus on urban operations and its commitment to the Global War on Terror. The focus now within the field artillery community and the munitions production industry is on the continuing improvement of a precision guided round for the 155mm cannon that yields greater range and accuracy. Central to this debate is the potential for precision delivery to supplant high explosive 'dumb round' area suppression as the traditional role of the artillery. This paper will examine the factors shaping this 'revolution:' past successes with precision weaponry and its role in Army Transformation, procurement and development costs and its impact on training, capability shortfalls and whether precision delivery will best satisfy the dynamic effects and attack guidance requirements for full spectrum warfare as specified in our National Military Strategy.

PRECISION AND THE BLUE COLLAR ARTILLERY

Ask any infantryman who has ever been in a firefight if he has enough artillery and he is likely to respond that one could never have enough artillery.[1] The maneuver Soldier's love for his close support gunners was dramatically reaffirmed by the artillery arm's magnificent performance during Operation Iraqi Freedom (OIF). Indeed, in a glowing post-war assessment, General(Retired) Barry McCaffrey called artillery the "dominant tactical weapon on the Iraqi Freedom Battlefield."[2] And now in the urban setting of counterinsurgency operations, the accuracy of precision delivery and the political imperative of containing casualties and minimizing collateral damage have sparked a lively debate around what type of munitions mix is best for countering the likely threats on the 21st century battlefield. Despite the celebrated and well documented success of artillery delivered precision guided munitions during OIF, conventional "dumb" munitions employed in their traditional role of massed, suppressive fires provided the vast majority of effective close support for maneuver forces. The research that follows suggests that while precision delivery represents an attractive employment option for confronting the dispersed, asymmetric nature of 21st century adversaries, precision weapons may not satisfy the dynamic nature and attack guidance requirements that typify the conditions of full spectrum warfare. Indeed, there is risk in placing too much emphasis on precision engagement "at the expense of combat proven battlefield capabilities."[3] Precision weapons may be too costly to field in sufficient numbers to facilitate routine training, their effectiveness is limited to specific target types and engagement criteria and they lack the essential capability of delivering sustained physical and psychological shock that is intrinsic to dominant maneuver warfare. Accurately delivered suppressive fires in close support of maneuver will remain the dominant role of conventional artillery.

The Precision Revolution Arrives

A new definition has emerged in warfare to describe munitions that can strike a target with extraordinary if not "precise" accuracy. "Precision" means that a projectile is "self-locating" and maneuvers to its target.[4] The world first witnessed the unprecedented accuracy and lethality of precision munitions on the Cable News Network during Operations Desert Shield and Desert Storm in 1990-91. Viewing audiences were treated nightly to the cloudy, green-black hued explosions of Maverick missiles striking concrete bunkers through the night vision crosshairs of an F-16's gun camera. Almost a decade later, General Wesley Clark used a protracted NATO air precision strike campaign in conjunction with the threat of a ground invasion as a diplomatic tool to leverage the Serbian withdrawal from Kosovo.[5] Precision strikes heralded a

technological revolution in the conduct of war that offered a host of attractive new options and capabilities. A precision guided weapon could destroy a military target and leave a nonmilitary target a quarter-block away untouched. Precision not only improved accuracy; it meant better survivability for aircraft and safety of ground forces. And since fewer projectiles could theoretically achieve the same effects as a greater number of rounds, logistics, transport, and storage requirements could be substantially reduced. With a dramatic, long-range, one-shot, one-kill capability with a low risk of civilian and material loss on an apparent budget friendly price tag, precision munitions presented a seductive prospect for politicians and combatant commanders alike.

Precision became the new lexicon of President Bush's Transformation Strategy to create "more lethal…easier to deploy and to sustain," weapons capable of striking at great distances with "pinpoint accuracy."[6] In a February 2001 speech at Norfolk Virginia, President Bush reiterated his commitment to a revolution in military transformation that he first described in a campaign speech at The Citadel nearly two years before. "Safety," he said, was "secured in … force projected over the long arc of precision guided weapons."[7] This transformation would require 'skipping' a generation in weapons development. The leap to new technologies would help trim an over-programmed defense budget built to finance Cold War era weaponry whose capabilities were deemed obsolescent against "information age" adversaries. The impressive performance of air-delivered precision guided weapons during Operation Enduring Freedom was the administration's opportunity to accelerate the cancellation of Cold War weaponry in favor of new technologies that enhanced mobility and precision. One of the first weapon systems to be considered for President Bush's chopping block was the Crusader self-propelled howitzer.

The 16 May 2002 hearings on the Crusader cancellation showcased both sides of the debate. In his speech to the Senate Armed Services Committee, Secretary of Defense Donald Rumsfeld explained that when the Crusader was validated as a requirement, the weighted criteria for its capabilities, rate of fire and maneuver, were in the context of a Cold War type fight. Precision, at the time, was not a consideration, and in view of the Afghan war experience, precision mattered.[8] General (Retired) Barry McCaffrey and General (Retired) Gordon Sullivan cautioned against over-reliance on precision munitions, that they were not the "silver bullet" that would render conventional close support of maneuver formations an antiquated doctrine.[9] McCaffrey warned that the future of warfare might not necessarily take on the nature of counterinsurgent or asymmetric adversaries, the premise that the administration employed in its Transformation strategy and its justification for the shift to precision weaponry. But the deciding

argument and final blow to Crusader was delivered by General Tommy Franks, commander of U.S. Central Command, who attributed one of the factors in the success of Operation Anaconda to the efficiency of air-delivered precision munitions. He said that given the "characteristics" of the fight in Afghanistan, Crusader would not have been the fire support weapon of choice.[10] The statement of a victorious combatant commander deprecating Crusader's utility in a contemporary fight was the clout the administration needed to drive the final nail in the program's coffin. Thus, the administration cancelled the Army's Crusader program, a self-propelled artillery weapon system whose metrics were inconsistent with the push for lighter, less logistics dependent systems, in order to shift funding to the development of artillery delivered precision munitions to bring the "precision revolution…witnessed in airpower, to the U.S. Army."

In the end, Congress arbitrated a compromise. Industry had invested the better part of seven years in Crusader prototype development and testing and there was much concern that its cancellation would result in the loss of advances in ammunition, automotive, and fire control technologies. Congressional officials recommended that the contractor, United Defense, should roll the Crusader technologies into the Army's overarching Transformation initiative, the Future Combat System (FCS). The compromise advanced Secretary Rumsfeld's agenda for Transformation on his terms, spared the lucrative Crusader technologies and, for the FA community, signaled the accelerated development and fielding of precision munitions.[11] Commenting on the landmark decision, Secretary Rumsfeld said that the fund shift from Crusader to the development of precision munitions technologies, where it could be used to "prove the truly transformational capabilities… will make the Army indirect-fire systems effective and relevant on the battlefields of the 21st century."[12] The decision to cancel the Crusader, he continued, and the emphasis on "accelerating a shift to precision munitions of all indirect fire systems," were one in the same.[13] Precision munitions became Transformation's "silver bullet." Senior FA and industry leaders rightly concluded that the future relevance and indeed fiscal survival of the field artillery arm very much depended on the zeal of their efforts in developing and institutionally promoting precision weapons.

This "silver bullet" is Raytheon's Excalibur GPS-guided precision round. In development since 1997, the Excalibur received renewed emphasis when MultiNational Corps, Iraq (MNC-I) forwarded an urgent needs statement for a precision guided munitions with "a circular probable error (CEP) independent of range" and with a "fire and forget capability."[14] Adapted for the M109A6 self-propelled Paladin and featuring a GPS-inertial guided unitary high explosive (HE) munition, developers estimated that it would reduce dispersion from 370 meters (for unguided munitions) to 10 meters. Recent tests show that the Excalibur's accuracy has exceeded these

estimates. In December 2004, two Excalibur rounds were tested at Yuma Proving Ground, Arizona. The rounds were fired at targets 20 kilometers distant and impacted 3.4 meters and 6.9 meters, respectively. [15] As in any new system, there were technical problems that had to be resolved. For example, the electronics had to be "hardened" in order for the sensitive GPS electronic guidance system to withstand the 16,000g setback and 275 revolutions per second forces on the round as it left the barrel and still retain its guidance capabilities.[16] On 15 September 2005, a Raytheon team at Yuma fired an Excalibur projectile equipped with an enhanced portable inductive artillery fuse setter (EPIAFS), achieved a direct target hit, and reported confidently that the Excalibur maintained a 10 meter CEP at all tested ranges.[17] Three months later, on 15 December 2005, the commandant of the Field Artillery, Major General David Ralston, proclaimed the results of the latest test firing, that an Excalibur round, fired at 22.8 kms impacted only 4.5 meters from the target.[18] Despite this unprecedented level of accuracy, leaders must temper the rush to precision with careful thought to the training ramifications of high cost ammunition and to whether precision munitions possess the capabilities of meeting the varied engagement conditions of a dynamic, target-rich, full spectrum battlefield.

Cost Impacts

Resource dollars drive training. When resources are costly, particularly separate loading artillery ammunition and its subcomponents, they are difficult to acquire in quantities sufficient to enable units to train with the consistency necessary to achieve and maintain combat readiness. Though it existed for years, the extraordinarily lethal Sense and Destroy Armor (SADARM) round, for example, with a $21,000 unit cost, was simply too expensive to field to artillery units for routine peacetime training.[19] Its limited pre-war production created an Army-wide training shortfall. The unfortunate result was discovery learning in combat. Prior to the commencement of ground combat during OIF, Ft. Sill faxed computational procedures and untested tactical guidelines to deployed units which had never trained with the SADARM. One white paper recommended 18-24 rounds per target, but 3ID FA units that employed SADARM observed that it yielded close to a one to one probably kill (PK) ratio.[20] 1-41 Field Artillery's after action report claimed that it fired 36 rounds of SADARM and "had huge success with it."[21] In one engagement near the town of An Najaf, 1-10 Field Artillery fired 54 rounds of SADARM, employing a fire order of a platoon one volley per target and reportedly destroyed or achieved mobility kills on over half of the armored vehicles.[22] But without access to training ammunition stocks and its corresponding fire control software to train in peacetime, it is impossible for units to achieve satisfactory levels of gunnery proficiency. The SADARM lesson was that hardware is

not enough, particularly when it is cost prohibitive. Raytheon expects one Excalibur round to cost approximately $29,000 to $35,000 once it is in production.[23] In comparison, unguided 155mm artillery high explosive rounds have a current procurement cost of about $500.[24] In other words, the Excalibur will provide a 10m CEP accuracy at 60 times the cost of conventional unguided high explosive ammunition. Will the Army fund the procurement of sufficient quantities of Excalibur rounds to allow units to train, identify problems in fire control software, develop troubleshooting workarounds and solidify standard operating procedures to forestall a repeat of discovery learning in combat? Faxing computational instructions to units on the eve of an attack is unacceptable.

Another consideration in the procurement and use of precision munitions in the long term is whether precision munitions are indeed more cost effective than unguided munitions, since theoretically, fewer precision rounds will achieve the same or better effects than a greater number of "dumb" rounds. In June 2003, the Undersecretary of Defense commissioned the Defense Science Board to assess the efficiency of guidance and munitions options against various target types. The Board used the Joint Munitions Effectiveness Manuals (JMEM) as the primary reference document for calculating the quantity of rounds that is required to achieve a desired "fractional damage" against target types, as a function of the accuracy of the sensor or target location error, the age of the meteorological data, etc.[25] While useful in deriving comparative values of munitions effects, the JMEM is a "guide" based largely on pre-Cold War historical data which estimates the quantities of rounds required to "halt or disrupt" massed armor forces on the attack.[26] Naturally, the tables recommend a large expenditure of unguided rounds for each target type. For example, the JMEM recommended 347 unguided 155mm rounds to achieve 30 percent fractional damage of a single tank. For the same target, the Board determined that a guided round required only 10 rounds and a "guided discriminatory" precision round required only one weapon to achieve the same effect.[27] Live fire tests, however, prove that conventional artillery can damage heavy armored vehicles, including tanks, with a considerably fewer number of rounds than listed in the JMEM. In a 1988 test, 56 HE rounds were fired at a variety of M113 and M577 armored vehicles and medium M-48 tanks. While the damage assessment model predicted 30 percent damage, the test achieved 67 percent damage.[28] In subsequent tests, direct HE hits consistently destroyed armored vehicles. Near hits, within 30 meters or aerial bursts of HE armed with a variable time fuse (VT), caused enough damage to neutralize the vehicles.[29] Effects on Iraqi armor during OIF corroborate this. Near Al Kifl, the 3d Infantry Division Artillery's two cannon battalions, the 1-41 FA and 1-10 FA augmented with MLRS battalion, attacked a Unmanned Aerial Vehicle (UAV) acquired enemy

motorized column and destroyed 21 vehicles.[30] While JMEM data can be used to buttress the argument of precision's cost efficiencies by a reduction in the number of rounds required to achieve effects, tests and experience in combat have shown that conventional ammunition can disable or destroy armored vehicles, even without a direct hit, with considerably fewer rounds than the tables represent, and consequently, at a substantially lower cost than precision munitions.

Precision's Shortfalls in Full Spectrum Conflict

The efficacy of a precision guided weapon is its signal one-shot, one-kill capability. "High confidence destruction of a single target…requires precise target location and a precision attack mechanism."[31] There is no advantage to an extremely accurate weapon against a target whose location cannot be precisely acquired. Targets, whether they are armored vehicles in the attack or a mortar crew in the bed of a 1978 Toyota truck, are dynamic, and do not necessarily cooperate with standard engagement criteria. Weather or battle conditions which create poor visibility can also hamper the sophisticated optics which normally render accurate target locations. Unless a target is stationary, like a command bunker or fixed communications node, it may move for any reason, whether it is taken under fire, or seeks protection or positional advantage. The Excalibur's GPS inertial guidance fuse will guide the projectile to the 10 digit grid coordinates that are programmed into it. Satellites will communicate with the fuse brakes (deployable fins) to adjust the projectile's trajectory in order to strike the originally programmed grid.[32] But if the target moves in order seek an improved protective posture (target posture sequencing) anytime between the initial voice or digital call for fire or while the projectile is in flight, the GPS guided fuse is not currently equipped with the seekers and data links to receive updated target location input in order correct its trajectory mid-flight, maintain a track with the moving target's location and guide to a precise intercept.[33] The Defense Board test showed that even when a projectile was denied GPS guidance for the terminal portion of its flight, it could achieve, at best, a 15m CEP.[34] According to the Defense Board, the technology for creating the target tracking data link exists, but at a cost of $15,000 to $25,000 for a single seeker and data link, it is unlikely to be pursued as a viable upgrade to artillery rounds.[35] Accuracy remains a function of target location.

At the tactical level during OIF, maneuver commanders repeatedly opted to employ conventional HE fires if targets could not be precisely located. [36] In a post-war interview, Brigadier General Lloyd Austin remarked that if a target's location could not be "pinpointed," conventional Paladin fires were used to good effect.[37] A July 2002 Center for Army Lessons

Learned article addressing lessons learned from Operation Enduring Freedom stated that "precision guided munitions are very accurate for specific coordinates, but not every mission lends itself to the requirement for specific coordinates."[38] On the future battlefield, there will be target sets and conditions which prevent the determination and/or transmission of an accurate target location which will dictate the prudent employment of unguided munitions as the most effective and, indeed, economical employment of combat power.[39] The full spectrum battlefield will not always present single, static, easy to locate targets.

One consideration for urban targeting situations is the accuracy of precision artillery munitions in engaging targets on a vertical plane. Is the GPS guided Excalibur round, for example, capable of defeating targets visible in a 4 th floor window without causing casualties in an office building one half block away? A 10M CEP may not yield the degree of accuracy required when the rules of engagement are specific regarding the mitigation of civilian casualties. In a 2002 Ammunition Symposium that addressed the precision characteristics of Excalibur, a Raytheon slide briefing depicted a simulated artillery attack on a single building in a crowded city with the intent of proving the relative inaccuracy of artillery high explosive by juxtaposing dispersion patterns of HE with Excalibur. The HE 'impacts' struck a number of other buildings with only one hit on the target building. The Excalibur slide displayed three 'impacts' on the building, but despite the "tight shot group" of a 10m (30 feet) circle probable error, it still lacked the degree of precision necessary to confidently rule out significant collateral damage.

Affordable precision guidance technology is the high-hurdle challenge. The key to progress is to continue efforts to combine off-the-shelf commercial quality of the silicon solid state design of micro-electro-mechanical (MEMs) inertial technology for precision weapons into a system design that includes GPS technology.[40] In addition, the Army should work with industry in developing a guided integrated fuse (GIF) that can be fitted to existing unguided "dumb" munitions. The GIF retrofit/conversion would provide an increased "near-precision" accuracy for conventional munitions, generate some logistics and training savings and help bridge the gap to full precision capability.[41] While seekers and data links seem to lie beyond the technological and budgetary horizon, the GIF replacement fuse, at an estimated cost of about $2,500, which includes the base unit cost of $500 for the standard HE M107 round, is a lucrative prospect in all quarters.

Another consideration for the guidance systems' development, peculiar now to information age warfare, is the vulnerability of the INS/GPS navigation to electronic jamming. Such was the concern over the prospective loss of air and ground delivered GPS guided precision accuracy during OIF, the Air Force employed F-117 Stealth bombers to destroy all known active Iraqi

GPS jammers.[42] Not surprisingly, following OIF, in order to maintain the accuracy advantage and added insurance against fratricide, civilian casualties and material collateral damage, the DoD directed that all U.S. weapon systems include an anti-jam (AJ) capability known as the GPS Selected Availability Anti-Spoofing Module (SAASM) as a design component.[43] In its recommendations, however, the Defense Board noted that the SAASM requirement was a "needless over-specification" for artillery and that the anti-jam requirement for these systems could be satisfied through less expensive means. Nevertheless, the anti-jam integrated fuse capability will require an inertial/AJ capability performance trade-off planning consideration. Users must determine how much AJ capability is required in view of the anticipated distance from the target that the GPS system would be lost and the corresponding desired level of accuracy compromised.[44] While precision delivers the promise of improved accuracy, it brings with it certain technical and tactical vulnerabilities and shortfalls which must be continually assessed as potentially limiting factors.

Indeed, there has been a tendency for industry to oversell precision munitions' capabilities and versatility in all types of conflict. Whereas precision munitions afford commanders the prospect of enhanced accuracy, their use under urban combat conditions and the desire to contain casualties and material damage in view of increasingly restrictive rules of engagement (ROE) requires perhaps an even greater scrutiny of target engagement criteria that has heretofore accompanied conventional engagements. Their effectiveness is certainly questionable in defeating multiple or moving targets that cannot be precisely located. The decision to employ precision munitions, then, must be accompanied by a host of target engagement guidance that is shaped by selection standards which account for sensor reliability and thus target location accuracy (TLE), the amount of anti-jam capability vice accuracy desired, the age of the acquisition report, the protection posture and dwell time of a target, and its proximity to sensitive non-military personnel or material.

The Utility of Artillery Suppression

Army Transformation and its theme of precision dominance have minimized the utility of suppression as the traditional role of artillery close support fires. In his forlorn defense of the Crusader, General (Retired) Barry McCaffrey was clear on his stand regarding the precision versus suppression debate. Countering the administration's precision argument, McCaffrey described the character of modern high intensity combat, "It's not all a precision battle. It's a suppression battle."[45] It is "…confused…getting pounded by 90 some odd artillery weapons, 100 plus mortars…we start putting suppressive fires and we then fire and maneuver." [46]

McCaffrey warned that it would be imprudent to forget about the U.S. mission to deter and if necessary conduct combat operations against the North Koreans, Syria, and defend Israel and Taiwan.[47] Combat operations against these states would require the full range of capabilities that would be employed in both mid to high intensity and urban conflict.[48] At risk is the loss of core competencies that would enable our close support artillery systems to counter potential future adversaries' conventional war-fighting capabilities. The hallmark of cannon artillery is its suppressive capability which has proven vital in the successful prosecution of all types of conflict. The suppressive feature of artillery must remain in the forefront of options because of its ability to kill and incapacitate and, in so doing, facilitate freedom of maneuver.

While artillery delivered precision munitions convincingly demonstrated their lethal capability during OIF with the 3d Infantry Division's use of SADARM, it was close support artillery, 105mm M119s, 155mm Paladins and Multiple Launch Rocket Systems (MLRS), employed in their traditional role of delivering massed area suppressive fires, which provided the most responsive and destructive fires of the campaign. The 101st Airborne Division Artillery, along with the 2d Battalion, 319th Field Artillery, 82d Airborne Division Artillery fired in excess of 4,000 105mm projectiles in close support of maneuver.[49] Notably, most 105mm fires were in support of decisively engaged infantry during urban operations. At An Nasiriyah, 1/10 Marines fired more than 2,000 rounds, consisting mostly of variable time (VT) fuse-equipped high explosive projectiles in support of its Task Force Tarawa. At Al Kifl, two Paladin battalions, 1-41 FA and 1-10 FA, firing for 3d Brigade Combat Team, repelled successive waves of attacking Iraqi infantry. Artillery's all weather, all-mission, fast response capability against massed, moving targets of all varieties was the key to the success of the major combat phase of OIF.

Suppressive fires and maneuver are inextricably linked. Indeed, so closely tied are fires and maneuver that S.L.A. Marshall, in his classic book on warfare, *Men Against Fire*, rightly said that "fire superiority is the thing and the movement is its physical and psychological derivative."[50] The former Soviet Union Army's bible on doctrine, *Tactica,* described the use of artillery to concentrate fires forward of advancing armor along narrow strike zones in order to suppress, neutralize, or destroy forces that would impede maneuver.[51] In the mid 1990s, American military doctrine writers borrowed the concept and coined the term "Fires-based Maneuver," whereby suppressive artillery or mortar fires enabled mechanized forces to close with and destroy the enemy. General William S. Wallace, commander of V (U.S.) Corps during OIF, said that the key to the Army's success was "Recon, shoot, move, then recon and shoot some more."[52] Conventional high explosive or Dual Purpose Improved Conventional Munitions (DPICM) used to suppress enemy air defense systems (SEAD) along the attack axis of aircraft

accomplishes the same purpose. Battlefield observers noted that as long as artillery rounds were impacting, soldiers, either mounted or dismounted, would remain under available cover rather than risk death or serious injury by exposure.[53] Since personnel chose cover instead of resistance, suppressive fires also impeded observation and thus prevented accurate return-fire. In *Attacks*, Erwin Rommel recounted the maneuver-enabling affect of suppressive artillery at the Twelfth Battle of the Isonzo in October 1917: "In the last quarter hour before the attack, the fire increased to terrific violence. A profusion of bursting shells veiled the hostile positions…(and) the defenders, in the turmoil of fire, did not see or resist… and we took advantage of the newly won area…"[54] In addition, suppressive fires could destroy antennas and radio equipment, thereby degrading command and control. If the fires damaged tracks, road wheels, or hydraulics, combat vehicles could be rendered immobile. With observation, communications, command and control capability, mobility and firepower impeded, the attacker then possessed the ability to close with the defender to within direct fire range without receiving the effects of accurate direct and indirect fire. As Rommel and others keenly noted, in achieving the complimentary, synergistic effect of fire and maneuver, the accuracy of the artillery was not as important as the volume.[55]

That artillery provides the volume, duration, and responsiveness that enable maneuver was also demonstrated during OEF and OIF. In his assessment of the heavy mortar fire endured by U.S. ground forces during the fighting in the Tora Bora and Shah-I-Kot mountains during Operation Enduring Freedom, former U.S. Army colonel and military theorist Richard Hart Sinnreich noted that effective suppression required fires of sufficient duration and area coverage and that artillery for this purpose was the first best weapon. [56] Aerial precision delivery during the Tora Bora action was not always responsive. In the action cited here, 10th Mountain Division Soldiers waited from 26 minutes to several hours to receive air support.[57] And because aerial precision usually involved one round delivered one time, unless it was a direct hit, it was not suppressive. [58] If a precision attack misses its target, enemy observation and fires may continue. LTC Patrick White, commander of 2d Battalion, 37th Armor Regiment, said in reference to the combat operations in and around Najaf, Iraq (OIF), "There were times when we needed precision weapons…but when the RPGs (rocket propelled grenades) were flying and between 50 and 60 mortar rounds were impacting, I'd much rather have my 155's dropping HE all over the place."[59] He added, "I want artillery to rock their world."[60] The one-shot, one kill capability of a precision guided artillery round is not the best means of responding to multiple targets presented simultaneously. Intermittently impacting rounds may not destroy a

target, but if the shock and concussion cause the enemy to discontinue the attack and seek cover, then the suppressive effect is achieved.

Artillery suppression elicits a debilitating psychological effect, albeit temporary, on an opposing force caused by fear.[61] Fear causes inaction. In terms of a battlefield effect, then, fear can be a viable combat multiplier. In his studies aimed at quantifying the relationship between artillery suppression and troop behavior, Dr. Michael Fineberg said that this fear manifested itself in the effect or action of 'not returning fire.'[62] In his analysis, he considered a host of factors and variables which collectively contributed to the suppressive qualities of artillery, such as visual signatures, intensity, duration, and the proximity of fires. He concluded that "the random distribution of fire throughout the target area is more suppressive than systematic patterns of fire."[63] The Russians employed this random distribution of fires to great effect during the Vistula-Oder campaign of January 1945. In this battle, the 1st Ukrainian Front used a phased delivery technique over the course of a 107 minute artillery preparation with fires impacting on targets throughout the German sector in varying degrees of time, volume, and intensity.[64] After five attack iterations delivered at irregular intervals, "large numbers of Germans became disoriented and began streaming, panic stricken, to the rear."[65] It was the intermittent application of fires, not a single, precise, massed strike that ultimately caused the collapse of the German forces. The combined variables of noise, intensity, duration, and proximity all contribute to this debilitating nature of voluminous suppressive fires that one-time, precisely delivered munitions cannot provide.

Why Replicate Suppression?

The steady migration away from suppression as the artillery's defining role is attributable, in some respect, to failures in our training institutions and methods. That is, the Army has lost its appreciation for suppression's versatility due largely to overly conservative artillery manual assessment tables and technology's failure to develop systems which can replicate suppressive fires in a simulated combat environment. Since 1982, Observer Controllers (OCs) at the National Training Center have told rotational units that it takes 54 rounds of HE to destroy a BMP (infantry fighting vehicle) and 108 rounds of HE to destroy a tank.[66] Despite the test research and our most recent combat experience in Iraq that disprove this, we have held units to this impractical standard which has a generation of leaders who, unless they have seen and experienced the effects of artillery in combat, believe that only massive, single strike artillery concentrations will inflict damage. The most pervasive, contentious issue, however, that

continues to bear on artillery relevance, is the inability to replicate the effects of suppressive fires in training.

There is immense training value in replicating the sights, sounds, and effects of combat as precisely as possible. Soldiers and, more importantly, their leaders, cannot learn how to react to or exploit a suppressive effect unless we can replicate it as faithfully as possible to the "real thing" in our training. Fineberg's research showed that Soldiers who were familiar with the lethality of weapons were 40 percent more suppressed than those who were not.[67] Until technology can visually and aurally replicate the debilitating effects of suppression on personnel, weapons, and equipment, the only way to understand the effect of six 155mm volleys impacting is to experience it on the receiving end in combat. The Combat Training Centers, Training and Doctrine Command (TRADOC) and the training simulation industry have struggled with this problem since the inception of the training centers.

Efforts to replicate fires have been limited to the Simulated Area Weapons Effects-Radio Frequency/Multiple Integrated Laser Engagement System (SAWE-MILES), the Combined Arms Training and Evaluation System (CATIES) and OC manual adjudication. The MILES-SAWE system at the NTC assesses successful artillery attacks, but the only visual effect is a blinking light and, if an OC is present, a hand-thrown artillery simulator detonated long after the lanyards are pulled. The Combined Arms Training Evaluation System (CATIES) system introduced in the early 1990s , was perhaps the best effort at aural and visual replication with a view toward compelling the crews to react appropriately. [68] CATIES consisted of a square aluminum block containing blank 12 gauge shotgun shells mounted on the rear turret of a combat vehicle. If the vehicle was in the footprint or the Indirect Fires Casualty Assessment (IFCAS) box tracked in the training analysis facility, the technician activated that vehicle's CATIES to indicate that it was under attack. The result was a high shrill whistle, an attempt to replicate an incoming round, followed by the detonation of shotguns shells, the number of which corresponded to the volleys that the vehicle absorbed. It usually caused the crewmen to "button up" and move. As crews became accustomed to the noise, however, unless an OC was present to enforce the ROE and appropriate 'under fire' behavior, it was ignored. All three systems fail to replicate suppressive fires realistically and thus create a false perception, indeed, an underestimation, of artillery effects. The result is Soldiers untrained in how to appropriately react to and exploit artillery effects.

Whereas it will remain impracticable to replicate the physical effects of suppression on personnel in training, i.e., bleeding eardrums, blown eye-sockets or disorientation, we must continue to explore technologies that will replicate suppressive effects on vehicles and their fire

delivery systems. Using Wayne Hughes' partial definition of suppression as a "non-lethal decrement in enemy combat performance," it is possible to identify what it means for a combatant and his instruments to be suppressed and translating that under strict safety guidelines in a combat simulation training environment.[69] Simply put, we need to improve the MILES-SAWE system to endow it with the capability of remotely replicating the degradation of a combat vehicle's ability to observe, move, shoot, and communicate. Until a system is developed that can remotely disenable all or in part of a vehicle crew's ability to observe, communicate, move, or shoot, suppressive fires will remain the province of actual kinetic combat.

Unrealistic artillery manual assessment tables and technology's failure to replicate suppressive fires at the CTCs together perpetuated doctrinally unsound lessons in fire support and combined arms doctrine. OCs used these tables as the basis for their coaching and instruction. Since precisely 54 HE rounds were required to kill a BMP, artillery units, for example, were coached that massing the battalion(s) was the only way to achieve the requisite combination of MILES "kill codes" to destroy an armored vehicle. The "When Ready" (WR) method of fire control, which allowed guns to fire once they were "safe and ready," and allocating platoon and battery missions for "suppressive" fires were readily discouraged. OCs coached that the WR method dissipated mass, created a visually unimpressive "popcorn" effect, compromised surprise and thus allowed targets to move in order to achieve improved protective postures. Units were coached instead to mass their fires using the "At My Command, Fire For Effect," method of fire control in order to deliver the all important single massed strike of overwhelming firepower. This method required all batteries to hold their fire until every howitzer was prepared to fire with the entire battalion. Depending upon the state of a unit's training, this sometimes caused interminable delays, in some cases from 15 to 20 minutes. Maneuver commanders, for a time, reluctantly accepted this, and in most cases embraced it, and tried to incorporate these techniques as standard procedures in home station collective training. Over the years, however, the same manner of delays and technical excuses wore thin on the patience of brigade commanders. More often than not, exasperated commanders left their artillery behind to work through their technical problems and continued their attacks without fire support. Many brigade combat teams spent two weeks in the Mojave sands without having learned the techniques and procedures to successfully synchronize maneuver and direct fire under the protection of artillery suppressive fires. Since the CTCs could not replicate suppressive fires realistically, units were coached in other engagement methods which taught them incorrect and uneconomical techniques in fires application. The value of "intermittently"

impacting rounds which the Russians used to great effect during the Vistula-Oder Operation was never learned and applied. Sadly, the result is a generation of Army senior leaders who continue to question the value and relevance of close support artillery and its ability to facilitate freedom of maneuver.

Conclusion

In sum, research shows that precision munitions alone cannot satisfy the target engagement requirements that are likely to appear on a future full spectrum battlefield. The asymmetric urban or conventional high intensity contests of the information age will create target sets, weather or battle-induced visual and electronic conditions which will either obviate the advantage of GPS accuracy or by pre-established target selection standards require the use conventional 'dumb' munitions to better achieve the desired effects. In view of the exorbitant cost of target tracking data links for guidance systems, precision guided munitions' first, best use will remain, at least for the foreseeable future, in the attack of fixed targets with precise 8 to 10 digit grid locations. Budget friendly guided integrated fuses will ensure affordable training and help bridge the accuracy gap until Excalibur and NLOS battalions are fully fielded. The Army should, nevertheless, continue to work closely with industry toward rapid prototyping, experimentation, and fielding of precision munitions. In view of SADARM's extraordinary lethality, the Army should work toward testing a family of SADARM like fuse munitions and target discriminating fuses and field them quickly. [70] The Army must retain a substantial base of conventional "dumb" munitions with its corresponding core of training competencies to best meet the myriad operational challenges of full spectrum conflict. Ammunition basic loads should reflect this proportionality in view of the nature and type of combat involved. Finally, our combat training centers must continue to work toward improving the replication of suppressive fires that will engender the correct integration procedures for artillery in all types future combat situations. While precision engagement can assist in shaping the battlefield, it cannot accomplish the host of operational requirements of the full spectrum battlefield. Success will be the applied balance between the technologies that give us on call precision and proven conventional capabilities. What remains constant is the dominance of the blue collar artillery to deliver accurate fires to maneuver forces 24 and 7 in every type of terrain, degree of visibility and weather.

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